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경영학석사학위논문

**External Knowledge Search, Organizational
Proximity, and Innovation Performance in
South Korean SMEs**

2014년 8월

서울대학교 대학원

경영학과 경영학전공

노 재 진

External Knowledge Search, Organizational Proximity, and Innovation Performance in South Korean SMEs

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이 논문을 경영학 석사 학위 논문으로 제출함

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ABSTRACT

In today's world, many of the firms have stepped towards open innovation to find their innovative performance rather than the concept of closed innovation. The concept of open innovation is to find external knowledge from variety of outside environment or source rather than internally. We adopt the concept of breadth and depth in order to explain how searching widely and deeper can affect firm's innovative performance. Our explanation on breadth and depth takes a shape of inverted U-shaped relationship to innovative performance. In order to moderate the relationship of breadth and depth to innovative performance, organizational proximity is adopted in respect to SMEs characteristic trait of innovation. This study will show how adopting organizational proximity can have a positive effect on firm's innovative performance.

Keywords: External Knowledge, Organizational Proximity, Open Innovation, Breadth, Depth, South Korea SMEs

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INTRODUCTION

This paper discovers the relationship between breadth and depth of innovative performances and how organizational proximity can moderate their relationship. In today's world, many of the firms have adopted the idea of open innovation from closed innovation, where external knowledge from different organization is the key knowledge in developing innovation (Chesbrough 2003). In previous studies, concepts regarding to open innovation first initiated from managers in large technology firms. Firm's potential performance came from variety of new ideas from innovation process. In search for new innovative opportunities, many firms invest time, money, and supplementary resources in their facility (Laursen & Salter 2006). The result of investment shows how firms can generate, custom, and recombines prior knowledge with new external knowledge. SMEs rely more on external resources due to their means of lack of knowledge (due to availability and capacity resource), which they consider associations or network for their innovation performance (Edwards 2005 and Rothwell, 1991).

In this paper we follow the work of Cohen and Levinthal (1994), Ahuja (2002), and Teece (1986) whom argued that the ability to extract external knowledge from different ties of channel is an important module for innovative performance. Extending from these studies, we also adopt the concept of breadth and depth as two components of open innovation of external search strategies and organizational proximity for complementary reasons. We discover that firms who have open search strategies, those who search widely and deeply, and with objectives tend to be more innovative. But the benefits to this innovative can have unfortunate returns, indicating too much of additional source can be unproductive to the firm. Breadth and depth is considered a key component when it comes to innovative performance of the firm, but with limitation of “over-scope” (Koput 1997), organizational proximity plays a key role in balancing out the relationship of inverted U-shaped relationship with innovative performance (Laursen & Slater 2006).

The research is based on a statistical analysis of the Korean Innovation Survey. The survey explores the innovation process inside firms and it contains sample of over 3000 manufacturing firms in South Korea. The method of analysis is a Tobit model where dependent

variable is innovative performance, which is explained by the firm acquired knowledge performance through different channels of resource and a number of control variables. The paper will discuss following: the development theory of open innovation and organizational proximity, which describes the hypotheses that drive the analysis. Next it will be followed by database, method and conclude with discussion and conclusions.

CONCEPTUAL BACKGROUND

The development of open innovation comes from some many series of literatures. Most of the studies are similarly linked into how external knowledge is important when extract a specific knowledge in order for firms to innovate. Cohen and Levinthal (1994) on “absorptive capacity,” states how exploit external knowledge can be lead to innovative capability. When utilizing outside knowledge, a firm must have a prior knowledge on which firms seeks. The reason for having diverse external knowledge sources is that to main all actors in the organizations to share different specialized language (Cohen and Levinthal 1994). Not only is having an external knowledge important,

but being able to think outside the box can also lead to efficiently innovate inside the firm. Utterback (1971), states that task performance and innovation is the result of diversity in the work setting, which can stimulate generation of new ideas. Ahuja (2002), literature on collaboration network likewise demonstrates how external knowledge can be transferred through different ties of network. When a firm has a direct ties to each other it results in knowledge sharing, complementarily and scale of information. But if there is an indirect tie the firm will have knowledge spillover. Ahuja (2002), argues how the degree to which firm partners are linked to each other will have different affect of how knowledge is transferred to individual ties of the firms.

Chesbrough (2003), “open innovation has been the recent example of research regarding the interactive distribution, and open landscape of innovation. Chesbrough (2003), has strengthened the limitation of pervious studies on external knowledge and re-created a model, which suggests that, the advantages that firms gain from internal R&D expenditure have declined. An advantage of internal R&D has strong ties with the able body of employee’s flexibility, but in todays world it is difficult for firms to appropriate and control their R&D investments

with “just” internal investment. This disadvantage of internal R&D lead to firms to search around their surrounding environment, and search in loosely coupled networks for different channels of resource in order to generate new ideas.

An imperative role of innovative performances comes from in what way firms’ behavior emphasis on open innovation and interface in studies of innovation suggest network of relationship between firms. For example there is a positive relationship between cooperation and innovative of outcome in a start-up organization (Shan, Walker, and Kogut 1994). In regards to different search engines, innovators rely heavily on their interaction with lead users, suppliers, and different variety of institutions around the innovation system (Von Hippel 1988). From recent studies of extracting new idea and knowledge the time of where lone entrepreneur bringing internal idea to the market has been outdated by different actors working together to succeed in exploiting new ideas to the market (Schumpeter 1942). Overall, these studies argument is important to firms with open behavior firms in their search for innovative opportunities.

SMEs on Open Innovation

In regards to firm's traits or characteristics on innovation, the mainstream of studies limit its focus on large firms (Hoffman 1998) and little courtesy is focused on SMEs characteristic to innovation (Shaw 1998 and Paniccchia 1998). SMEs and larger firms open innovation will vary due to their dissimilar innovation processes (Vossen 1998). The innovation processes of SMEs have not been completely defined on the terms of open innovation (West 2006). But Laursen and Salter (2004), states how SMEs compared to larger firms are not worst off when it comes to innovation. This statement argues how SMEs are capable of generating aptitude for innovation. The advantage characteristics of SMEs are 'flexibility' and 'proximity' in accelerating innovation; firms also have limited capacity to control total innovation development, which will likely to seek other firms for collaboration (Edwards 2005). Because SMEs lack in resources and operation facility, it might affect them in manufacturing, distribution, marketing and R&D expenditure, which can be essential in product, process, and organization innovation. Their errors in lack of reserve may lead to higher R&D productivity than larger firms, but there is still

much argument on the topic of open innovation of SMEs because of their disadvantages compared to larger firms (Audretsch and Vivarelli 1996).

SMEs usually focus their targets on performance, while larger firms mainly focus on R&D in open innovation. Because SMEs lack the support of manufacturing facilities, marketing, and contacts globally, which in result makes them ineffective in open invention, so they priorities their goals into technology invention (Narula 2004). For successful innovation SMEs must know which market is important to them (Rosenberg and Mowery, 1978), and SMEs' open innovation can take benefit of this knowledge to benefit their achievement in exact market.

In order for SMEs to compete in today's market, the firms must achieve economies of scale, successfully market their products, and deliver the customers with unresolved services. Because SMEs lack the resource, the firms will likely to cooperate with other firms to advance their innovative performance. SMEs are flexible and peripatetic when it comes to innovation, and large firms are less flexible, but tend to have clearer resource to produce and develop inventions of products and process. The large firms will call forth on

SMEs to collaborate with them to satisfy flaws in their system of innovation. There can also be a downside to working with a larger firm, due to exposure of knowledge competence. Larger firms resolve more flexibility and negate comparative advantage of SMEs and lose opportunities to compete against them (Narula 2002). This can result in great opportunities for the SME in open innovation if the firm has a strong tie with the large firm (Rothwell 1991.)

Knowledge Exchange And Organizational Proximity

How does one firm acquire knowledge? What roles from different factors such as distance or opportunity play the establishment of knowledge-exchange in the innovation process? Until this days a worldwide development and dynamic economy in technology organization, organizational proximity seems to play a crucial role in innovative performance. Many authors have highlighted the importance of organizational concentrations of firms especially for innovation activities. Proximity has been the subject of considerable research over the past three decades. Three dissimilar studies have produced almost the entire amount of proximity research. The three approaches are: the

linear distance approach, the practical approach and the psychological approach. The distance approach treated proximity as a linear distance between people, within short distance (same area). To further extend from origin study of proximity, professors around the world have studied the impending relationships between people and related variables. Nonverbal interaction was one of extended study of proximity, which proximity had positive influence Coutts and Ledden (1977) and Allgeier and Byrne (1973) found a negative relationship between proximity and the aggravation of anxiety, hostility and depression, but Tesch (1979) found no relationship between proximity and emotional activities.

Organizational proximity is just one of several possible proximity dimensions between actors. As the most predominant form it describes the external knowledge between different external actors. Organizational proximity is referred to as face-to-face meetings and in exchange of implied knowledge. It also supports the formation of other scopes of proximity. Organizational proximity is defined as the degree to which families are shared in an organizational arrangement, either within an organization, or between organizations. Between firms organizational proximity exists for example when they belong to the

same group. It can also be created through the establishment of networks or joint ventures. Organizational proximity fulfills a very important function that is to reduce uncertainty. Asheim and Gertler claim that the increasing information strengthens (internal & external knowledge) the economy causes a stronger organizational enlargement of innovation activities.

HYPOTHESES

External Search Breadth and Depth

An origin of breadth and depth comes from an organizational learning of exploration and exploitation. To develop idea of breadth, Huber (1991) states that the search in organizations is a piece of puzzle of the organizational learning process through which firms attempt to solve problems in an ambiguous world. Organization that search locally address problems by using knowledge that is closed related to their pre-existing knowledge bases. Also March (1991), a new variation is necessary to provide a sufficient amount of choice to solve problems. Extracting external source is key idea of innovation, but know-how of

knowledge is also crucial. The search efforts of firms can vary not just in their scope but also in their depth, which is the degree to which existing knowledge is reused or exploited. Since search strategies are rooted in the past experiences and future expectations of managers, it is difficult for many organizations to determine the “optimal” search strategy in terms of being “broader and deeper” (Levinthal and March 1993).

In order for organization to innovate an organization must adopt to the ability of investing wider and deeper (Laursen and Salter 2006). In innovative activities, the concept of breadth is defined as how organizational uses different external search depth in order to gather external knowledge. Next, the depth is defined as how a organization can deeply absorb an acquired external knowledge through external search channels. Breadth and depth variables together represent the open innovation of firm’s external search channels on knowledge.

Previous studies are pertinent to our approach. In a specific industries, the technological knowledge surrounding the industry molds product search and innovative performance (Katila 2002). Katila’s study on robotic industries argues that innovative performances were affected by how firms can acquire knowledge from different channel of

resource. Extending the study on Katila and Ahuja (2002), we argue that external search “breadth” has a positive relationship to innovative performance. In order for organization to gain innovative performances, the firm must go through patterns of trial and error from the external source. It requires general effort and time to construct an understanding of the customs, conducts, and procedures of different external knowledge channels (Laursen and Salter 2006).

Regards to depth, a key sources for external search channels are frequently lead users, suppliers or universities (Von Hippel 1988). For the following external search channel, a firm should be able to consistently continue their learning with wide range of teamwork. Evaluating the depth of a firm’s contacts with dissimilar external sources provides a method for considering the way firms use exploration to deeply examine the external sources, which are integrated into internal innovative efforts. We predict that firms who deeply study the knowledge of external sources to be more innovative, since they are able to shape and sustain collaborations with external search channels.

Although we theorize that external search breadth and depth is associated with innovative performances, we also argue that firms may

“over-search” and that this will have negative consequences for their innovation performances. According to Koput 1997, in forms that firms who extract new ideas can not absorb all knowledge and can not choose what is the “fit” for their firm. Next, the knowledge may come at a wrong time or place, which a manager can adsorb the information properly. Sometimes when knowledge is gathered from the external channel managers does not know if the knowledge is useful or not. Koput’s model of innovative search and the attention-based theory of the firm suggest that there is a point which external search breadth and depth have its disadvantageous.

H1. Breadth and depth of external search knowledge has an inverted u-shaped relationship to innovative performance.

Organizational Proximity

Organizational exercises are important to the issue of collaborating learning. While a basic knowledge background and capability is a precondition for the firms and aiding collaborating learning. But knowledge creation is depended on a capacity to manage the exchange

of external pieces of knowledge by a variety of different channel within and between organizations (Monge 1985). Organizational proximity is referred to the same area of relatives, communications of numerous environments. In other reasons, it comprises resemblance in which different channels are connected by exchanging the same indication location and knowledge. Frequently dissimilarity is made between an inter-organizational relation of similarity and an intra-organizational relation of membership. For Kirat and Lung (1999), organizational proximity mentions set of interdependencies within as well as between organizations associated by a relationship of either monetary dependence/interdependence and between employees of an manufacturing or economic group, or within a network. To estimate the organizational proximity between different channel of resources in according to SMEs preference, hierarchical dependences and/or strategic alliances, in terms of “R&D partnerships,” are considered (Petruzzelli 2009). In particular, concentrating on the organizational links between external resource channels located inside a technology district and actors located worldwide it is assumed that the business units of companies located in a district are connected mainly through organizational proximity. In our study we will adopt organizational

proximity as the extent to which relations are shared in an organizational arrangement, either within or between organizations.

Organizational proximity is believed to be beneficial for learning and innovation. New knowledge creation from different channels of resource goes along with uncertainty and opportunism (Monge 1985). Also strong control mechanisms are required in order to ensure ownership rights and sufficient rewards for own investments in new technology. In principle, a controlled organization or tight relationships between organizational units can deliver a resolution to these problems. Moreover, the transfer of intricate knowledge requires strong ties because of the need of response. Hansen (1999), showed that strong rather than weak ties between units in a various organization stimulate the transfer of complex knowledge in product development projects.

So how is organizational proximity beneficial towards SMEs manufacturing firms? SME form of operation gives positive feedback is less common to more symmetrical relations. Consequently, new ideas are more satisfied in a flexible system and interactive learning hardly takes place. Small firms are likely to be relatively strong in innovations where effects of scale are not important and where they can make use of their *flexibility* and *proximity* to market demand, such as new

products or product-market combinations, modifications to existing products for niche markets, and small-scale applications (Vossen 1998). Third, the implementation of innovation requires organizational flexibility (Blanc and Sierra, 1999). Organizational proximity, as reflected in a hierarchical governance structure (large firm), is unlikely to provide such flexibility. The tighter and more dependent are the relations in an organizational arrangement, the less initiatives are undertaken and rewarded, with negative effects on flexibility and innovation (Frenken and Valente 2002). SMEs advantage of flexibility can benefit from open access to various sources of information, meaning a broader learning interface, which means it will reduce the likelihood to over-search.

SMEs rarely have all required resources internally to innovate successfully. As a result some of these resources have to be acquired externally. Because resources are varied innovating firms have to be knowledgeable about their uses and performance. For external resources, firms who learn by interacting can actively make use of the knowledge and experience of a variety of economic actors in their network (Hakansson 1993). Learning by interaction depends on the capacity to coordinate the exchange of complementary pieces of

knowledge owned by a variety of actors within and between organizations (Boschma, 2005).

Recall how too much breadth and depth can have a negative affect on innovative performance (Laursen and Salter 2006). Organizational proximity has specific trait of how one organization should seek knowledge in today's world. Newcomb (1961) assumed that organizational proximity promotes readiness of communication, as a result of which individuals have an *opportunity* to discover each other's common attitudes. This narrows down how SMEs search on knowledge. If an organization seeks a specific knowledge, it will meet an organization with a similar interest in order to seek opportunity. In regards to Koput's wrong place problem, Monge 1985 states organizational proximity is when two or more people being in the *same location* where there is both the opportunity and psychological obligation for face-to-face communication. In pervious studies, regards to how external knowledge is acquired, it does not extend the study on how external knowledge was to be gathered. Knowledge of the dynamics of organizational proximity can be used to assess whether the desired level of face-to-face contact is occurring. If not enough contact occurs; management can alter the physical space, frequency of

meetings, and other organizational attribute to increase the contact level (Monge 1985). Organizational proximity can define how SME can choose specific knowledge, time, and place and better able to exploit a host of search channel in terms of breadth and depth of innovative performance.

H2. Organizational proximity moderates the inverted-U shape between breadth and depth of external search knowledge and innovation performance.

DATA AND METHOD

In this paper, the Tobit regression is accepted to control the censored data of three independent variables. Censoring from sample takes place when a value at or above some threshold, all take on the value of that threshold, so that the correct value might be equivalent to the level, but it might also be greater. In the heave of censoring from below, values those that fall at or below some threshold are censored (Breen 1996 and Greene 2000). For the empirical analysis, the data from the Korean Innovation Survey (KIS) 2010 conducted by the

Science and Technology Policy Institute (STEPI) were used. To concentrate on the external knowledge search activities, the sample is limited to the manufacturing firms from C10-C33.

Measures

Dependent Variable

We use various means of external knowledge to reflect how innovative performance is performed by the firm. To measure the relative scope of innovation results, firms were asked to indicate to which external knowledge was valid inside an organizational innovation survey. The various means of external knowledge was measured through external search knowledge of breadth and depth: (1) reductions of cost prices, (2) quality improvements of organizational communication, (3) increase in organizational operations, (4) improvements in delivery time, (5) increase in sales (6) increase in profits.

Independent Variable

As determinants of innovative performance, we announce binary new variables replicating openness in terms of external search strategies of firms (Leiponen and Helfat 2003). The leading variable is termed BREADTH and is raised as combination of respectively available source for dependent variable. As a starting point, each of the bases are coded as a dual variable, 0 being no use and 1 being use of the given awareness source. Then altogether, sources are basically added up thus that each firm acquire a 0 at what time no knowledge sources are used, although the firm gets the worth of specific total number, when entire knowledge sources are used. In other words, it is expected that firms that practice higher numbers of sources be above “open” with regard to search breadth.

External search depth is defined as the amount to which firms attract intensively since altered search channels or sources of innovative ideas. According, the following variable is named DEPTH and is assembled using the similar sources of acquaintance as those used in creating BREADTH. In this condition each of the sources are implied with 1 when the firm in questions reports that used the source to a high mark and 0 in the case of no, low, or medium use of the given

source. As in the case of BREADTH, the bases are subsequently added up so that each firm gets a core of 0 when no knowledge sources are used to a high degree, which the firm get the importance of max number of sources when all knowledge sources are expended to a high degree. Again, it is anticipated that firms that use elevated numbers of sources are beyond “open” with regard to search depth.

Two descriptive variables BREADTH & DEPTH are delegations for the breadth and depth of firms’ external knowledge search. The KIS 2010 provides information on how extensively and intensely external knowledge sources are used. For example, the survey asks a firm; whether a firm has used what different sort of external networks, if it has, how important each of the sources was. The survey lists 8 external knowledge sources: private research institute, university laboratories, government funded research institutes, nonprofit organizations, firms within the groups, competitors, etc.

Control Variable

First in order to control our result, we have included organizational proximity (orgprox), which was distinguished through different external actors. This variable is based on how two or more

organization met for opportunity reasons: (1) suppliers, (2) clients, (3), competitors, (4) consultants, (5) commercial laboratories (6) universities (7) government organizations. Other controlled variables were sales of SMEs firms of manufacturing firms in South Korea (KIS C10-C33), which showed the size of the firm. The age of the firm, which defined as how long firms have survived from their established years. Also number of researchers employed by the firms has been controlled. Lastly, a products life cycle of each firm has been controlled.

RESULTS

Table 1 through 6 presents estimates of Tobit regression of breadth and depth to innovative performance and how organizational proximity moderated their relationship. When looking at Table 1 the breadth and depth relationship to innovative performance is presented with a positive relationship (linear). Breadth's coefficient (0.7305339) and depth (1.009765) shows positive effect to innovative performance. Also regards to Chi (squared) and p-value it showed significant relationship to innovative performance. But recall Koput's theory on

“over-scope,” and how too much of breadth and depth can have a negative affect on innovative performance. Table 2 through 4 strongly supported hypothesis 1 for how external search of breadth and depth can have inverted u-shaped relationship to innovative performance. Breadth squared (-0.0893957) and depth (-0.1846097) had a negative coefficient meaning too much breadth and depth can result in negative effect on innovative performance leading to inverted u-shaped curve (Laursen and Salter 2006). Next Table 5 and 6 shows how organizational proximity can moderate the relationship between breadth and depth to innovative performance. In order to match the data of breadth and depth squared, organizational proximity was also squared to see if had a positive effect on breadth and depth regression. Table 5 showed significant result as organizational proximity coefficient had (-.0088238) and p-value being (0). Table 6 showed no significant result as organizational proximity coefficient was (-0.00158), but P-value had a (0.613).

DISCUSSION AND CONCLUSION

Firms are increasingly drawing in knowledge from external sources in their innovative activities. Modern innovation procedures require firms to have highly specific information about different users, know-hows, and markets. To extend our understanding about in what way firms lure knowledge from external sources, the current study examined the position of external search approaches in shaping innovative performance. This paper has investigated the role of firm's external knowledge search behavior in terms of both the breadth and depth of search. Laursen and Salter (2006) focused on the effects of firms external search breadth and depth on innovative performance. Following their study, this paper extended the study area to the role of external knowledge search breadth and depth to innovative performance and how organizational proximity can moderate their relationship.

From our studies organizational proximity did have an affect on too much breadth and depth, which resulted in inverted u-shaped curve on innovative performance. General effect of contributions of external actors to the innovative performance was found. The organizational

technological knowledge embodied in these different external channels turn out to be the most value for the relative innovative performance of firms in the survey. In our founding as relative external knowledge for organizational proximity was studied it needed to be done in broader search of variety of external contributions to matter. Even though organizational proximity coefficient had influence on breadth and depth on a coefficient level, depth regards to p-value did not have a significant relationship on innovative performance. Organizational proximity was meant for two organizations to meet face-to-face for communication in order to transfer knowledge if opportunity was presented. It was not clearly defined how knowledge was to be absorbed through their organization after knowledge was acquired.

Limitations and Future Research

There are many controversies between larger firms and SMEs way of how open innovation works. Most of the paper states how SMEs lack in resource, which concludes how open innovation, is important to smaller size firms. There are limited studies, which go beyond SMEs characteristic trait when it comes to open innovation. A repetitive

argument on SMEs' way of innovation might have resulted in a bias conclusion on how under different circumstance of different innovation can lead to positive relationship. Also, the organizational proximity data was limited to SMEs, and in our surveys there were numerous zeros, which meant many of the firms did not volunteer to share their information in the survey. If we could run a regression with even more data, it can show an accurate relationship to how organizational proximity can influence a relationship to SMEs open innovation.

Organizational Proximity is just one of variable from other proximity. If a study can be extended to other proximity to see any influence on the “over-scope” of innovative performance. There is always a percentage where too much of “what” can be lead to inverted u-shaped relationship between an x to innovative performance. From different external channel of resource it should be focused on which external source is the likelihood of most supportive in innovative performance.

When perceiving the result from our regression, compared to breadth, depth had a higher coefficient. It would be an interesting study to compare the breadth and depth concept of Katila & Ahuja (2002). There is limited studies on definition and method on how depth is

calculated, if one can come up with a different theory on how depth can be measured it would demonstrate why depth displays a higher relationship in SMEs open innovation. Additional future exploration encounter is to deteriorate the changes in innovative search over period. With upcoming innovation surveys, it will be possible to examine where the examine performance of innovative firms has rehabilitated over period as suggested by Chesbrough.

Table 1.

Tobit regression

Number of obs = 3859

LR chi2(7) = 1589.49

Prob > chi2 = 0.0000

Log likelihood = -3650.7667

Pseudo R2 = 0.1788

orginno	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
age	-.0114846	.0110797	-1.04	0.300	-.0332072	.010238
lnsales	.1855865	.0653975	2.84	0.005	.0573695	.3138036
a6c3	.0000224	.0000302	0.74	0.458	-.0000367	.0000815
a4	-.000775	.0003568	-2.17	0.030	-.0014745	-.0000755
orgprox	.5174498	.0811608	6.38	0.000	.3583276	.676572
breadth	.7305339	.0469835	15.55	0.000	.638419	.8226487
depth	1.009765	.068205	14.80	0.000	.8760436	1.143486
_cons	-12.17274	.7306182	-16.66	0.000	-13.60518	-10.74031
/sigma	5.964347	.1638075			5.643189	6.285505

Obs. summary: 2937 left-censored observations at orginno<=0

872 uncensored observations

50 right-censored observations at orginno>=12

Table 2.

Tobit regression

Number of obs = 3859

LR chi2(7) = 1413.88

Prob > chi2 = 0.0000

Pseudo R2 = 0.1590

Log likelihood = -3738.5704

orginno	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
age	-.0064121	.0120219	-0.53	0.594	-.0299819	.0171578
lnsales	.3040382	.073169	4.16	0.000	.1605845	.4474918
a6c3	.0000146	.0000337	0.43	0.664	-.0000514	.0000807
a4	-.0006295	.0003951	-1.59	0.111	-.001404	.0001451
orgprox	.6629509	.0881824	7.52	0.000	.4900623	.8358394
breadth	2.253132	.181901	12.39	0.000	1.896501	2.609764
breadth2	-.0893957	.0133823	-6.68	0.000	-.1156326	-.0631587
_cons	-16.305	.9768223	-16.69	0.000	-18.22013	-14.38986
/sigma	6.494893	.1797222			6.142534	6.847253

Obs. summary:

2937 left-censored observations at orginno<=0

872 uncensored observations

50 right-censored observations at orginno>=12

Table 3.

Tobit regression

Number of obs = 3859

LR chi2(7) = 1416.30

Prob > chi2 = 0.0000

Log likelihood = -3737.3629

Pseudo R2 = 0.1593

orginno	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
age	.0079587	.011159	0.71	0.476	-.0139193	.0298367
lnsales	.3327543	.0626898	5.31	0.000	.209846	.4556625
a6c3	.0000288	.0000299	0.96	0.336	-.0000299	.0000875
a4	-.0017084	.0003554	-4.81	0.000	-.0024051	-.0010116
orgprox	.6590765	.0839765	7.85	0.000	.4944337	.8237192
depth	3.140306	.1641762	19.13	0.000	2.818425	3.462186
depth2	-.1846097	.0180115	-10.25	0.000	-.2199227	-.1492967
_cons	-11.98164	.7188962	-16.67	0.000	-13.3911	-10.57219
/sigma	6.172736	.1707605			5.837946	6.507526

Obs. summary: 2937 left-censored observations at orginno<=0

872 uncensored observations

50 right-censored observations at orginno>=12

Table 4.

Tobit regression	Number of obs	=	3859
	LR chi2(9)	=	1650.28
	Prob > chi2	=	0.0000
Log likelihood = -3620.3712	Pseudo R2	=	0.1856

orginno	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
age	-.0117411	.011181	-1.05	0.294	-.0336624	.0101802
lnsales	.2596741	.0685844	3.79	0.000	.1252089	.3941394
a6c3	.0000226	.0000306	0.74	0.461	-.0000374	.0000827
a4	-.0005473	.0003671	-1.49	0.136	-.0012669	.0001724
orgprox	.5513611	.0816969	6.75	0.000	.3911878	.7115343
breadth	1.529113	.1760233	8.69	0.000	1.184005	1.87422
breadth2	-.0676223	.0128063	-5.28	0.000	-.0927301	-.0425146
depth	1.608712	.1751434	9.19	0.000	1.265329	1.952095
depth2	-.0707326	.0186281	-3.80	0.000	-.1072544	-.0342108
_cons	-14.77572	.9025937	-16.37	0.000	-16.54533	-13.00611
/sigma	5.970649	.1639467			5.649218	6.29208

Obs. summary: 2937 left-censored observations at orginno<=0
 872 uncensored observations
 50 right-censored observations at orginno>=12

Table 5.

Tobit regression

Number of obs = 3859

LR chi2(8) = 1427.12

Prob > chi2 = 0.0000

Pseudo R2 = 0.1605

Log likelihood = -3731.9507

orginno	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
age	-.0068692	.0119939	-0.57	0.567	-.0303842	.0166458
lnsales	.3059541	.0729707	4.19	0.000	.1628891	.4490191
a6c3	.0000144	.0000337	0.43	0.668	-.0000516	.0000805
a4	-.0005619	.0003946	-1.42	0.155	-.0013356	.0002118
orgprox	1.67371	.2905733	5.76	0.000	1.104018	2.243402
breadth	2.154342	.182771	11.79	0.000	1.796004	2.512679
breadth2	-.0795191	.0135798	-5.86	0.000	-.1061434	-.0528948
b2prox	-.0088238	.0024151	-3.65	0.000	-.0135588	-.0040889
_cons	-16.31249	.975613	-16.72	0.000	-18.22525	-14.39972
/sigma	6.474328	.1789971			6.123389	6.825266

Obs. summary: 2937 left-censored observations at orginno<=0

872 uncensored observations

50 right-censored observations at orginno>=12

Table 6.

Tobit regression

Log likelihood = -3737.2356

Number of obs = 3859
 LR chi2(8) = 1416.55
 Prob > chi2 = 0.0000
 Pseudo R2 = 0.1593

orginno	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
age	.0078784	.0111646	0.71	0.480	-.0140106	.0297674
lnsales	.3327674	.0627168	5.31	0.000	.2098061	.4557287
a6c3	.0000289	.00003	0.96	0.335	-.0000298	.0000876
a4	-.001702	.0003557	-4.78	0.000	-.0023994	-.0010045
orgprox	.6961562	.1116146	6.24	0.000	.4773268	.9149857
depth	3.131468	.1650184	18.98	0.000	2.807936	3.455
depth2	-.1823522	.0185411	-9.84	0.000	-.2187035	-.1460009
d2prox	-.00158	.0031272	-0.51	0.613	-.0077111	.004551
_cons	-11.99127	.7195908	-16.66	0.000	-13.40209	-10.58046
/sigma	6.174648	.1708707			5.839643	6.509654

Obs. summary: 2937 left-censored observations at orginno<=0
 872 uncensored observations
 50 right-censored observations at orginno>=12

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국문초록

한국 중소기업의 외부지식탐색, 조직 근접성, 혁신성과에 관한 연구

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오늘날 기업들은 기업 내부의 폐쇄적인 탐색에 머무르지 않고 개방형 혁신을 통해 혁신성과를 제고하고 있다. 개방형 혁신이란 조직 외부에 존재하는 다양한 지식을 탐색함으로써 새로운 아이디어를 창출해내는 과정을 뜻한다. 본 논문은 기업의 지식탐색의 폭과 깊이가 어떻게 혁신성과에 영향을 미치는지를 연구한다. 연구결과에 따르면 기업 탐색의 폭과 깊이는 각각 혁신성과에 역 U 자형의 영향을 미치는 것으로 나타났다. 또한, 중소기업 혁신의 중요한 특징인 조직 근접성이 위의 영향을 조절하는 것으로 밝혀졌다. 본 연구결과는 중소기업들이 조직 근접성을 이용하여 혁신성과를 효과적으로 제고할 수 있음을 나타내고 있다.

주요어: 외부 지식, 조직 근접성, 개방형 혁신, 폭과 깊이, 한국 중소기업

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